



PostgreSQL

DBA Training

Surendra Panpaliya



Surendra Panpaliya, DTM

**Founder & CEO, GKTCS Innovations –
building future-ready enterprises.**

**Empowered 35,000+ IT professionals
through training, mentoring, and
consulting.**

**Partnered with 300+ multinational
corporations to accelerate business
growth.**

Agenda



DAY 1 — PostgreSQL Foundations, Architecture & Tools



DAY 2 — Transactions, Locking & Maintenance



DAY 3 — Query Optimization & Indexing



DAY 4 — Backup, Replication Concepts & Migration

A. PostgreSQL Introduction

PostgreSQL capabilities overview

PostgreSQL vs Oracle vs SQL Server vs AWS RDS PostgreSQL

Architecture differences (Local vs RDS)

MVCC high-level concept

Key differences vs enterprise databases

A. PostgreSQL Introduction

Fidelity Use Case

PostgreSQL used for

Investment reporting, portfolio views, microservices

Oracle retained for **core settlement / legacy systems**

RDS PostgreSQL used for **managed production workloads**

B. PostgreSQL Local Architecture (1 hour)



Cluster structure



(data directory, instance, databases, schemas)



Key processes



postmaster, autovacuum, WAL writer, checkpointer

B. PostgreSQL Local Architecture (1 hour)

Memory architecture

WAL, checkpoints, background writer

MVCC row versioning

Fidelity Use Case

Gurugram supports multi

DB clusters → shared memory understanding critical

UK latency SLAs → WAL & checkpoint behavior matters

China read-heavy compliance queries → MVCC benefits

C. Tools Overview & Connectivity (30 minutes)



psql vs pgAdmin (DBA usage patterns)



Connecting locally

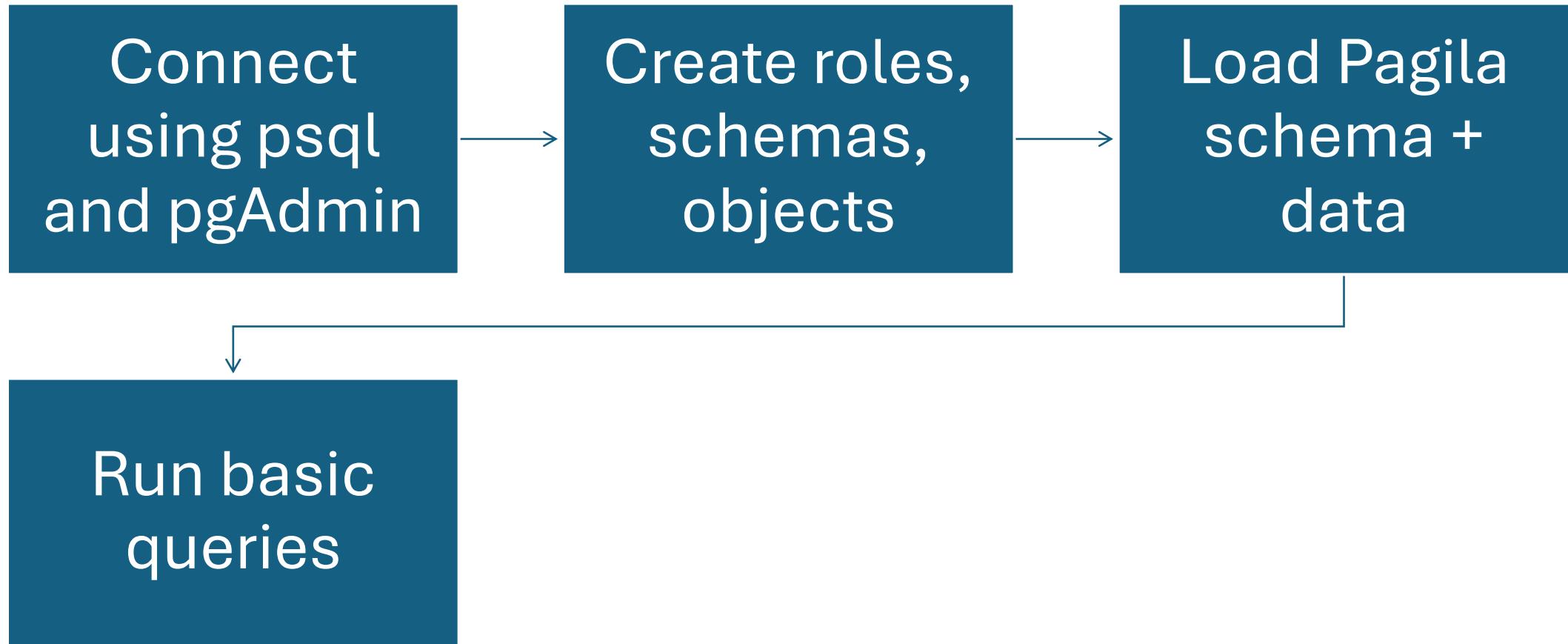


Roles, databases, schemas



Pagila dataset overview

D. Hands-On Lab



D. Hands-On Lab

Measure
performance
using:

\timing

EXPLAIN /
EXPLAIN
ANALYZE

Explore system
catalogs:

pg_class

pg_stat_activity

Module-wise FAQ — Day 1



Q1. Is PostgreSQL production-ready for financial systems?



Q2. How is PostgreSQL different from Oracle RAC?

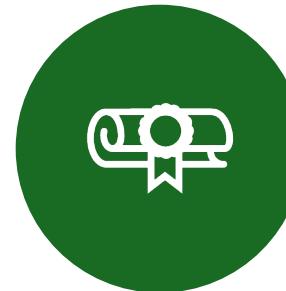


Q3. Why do DBAs still need architecture knowledge in RDS?

Ice Breaker Activity (5 minutes)



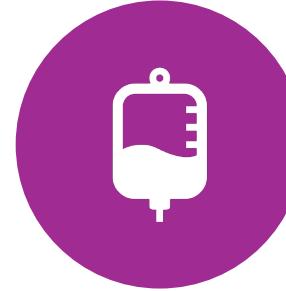
**Activity: “Same DBA,
New Engine”**



Who here has **10+ years
on Oracle?**



**Who is already
supporting PostgreSQL
in production?**



Who supports **RDS
PostgreSQL today?**

Discussion Prompt



If PostgreSQL is open-source,



why are banks and asset managers trusting it



with billions of dollars?

Agenda

Introduction to PostgreSQL

History and development of PostgreSQL

Key features and benefits of PostgreSQL

PostgreSQL vs. Oracle database systems

Agenda



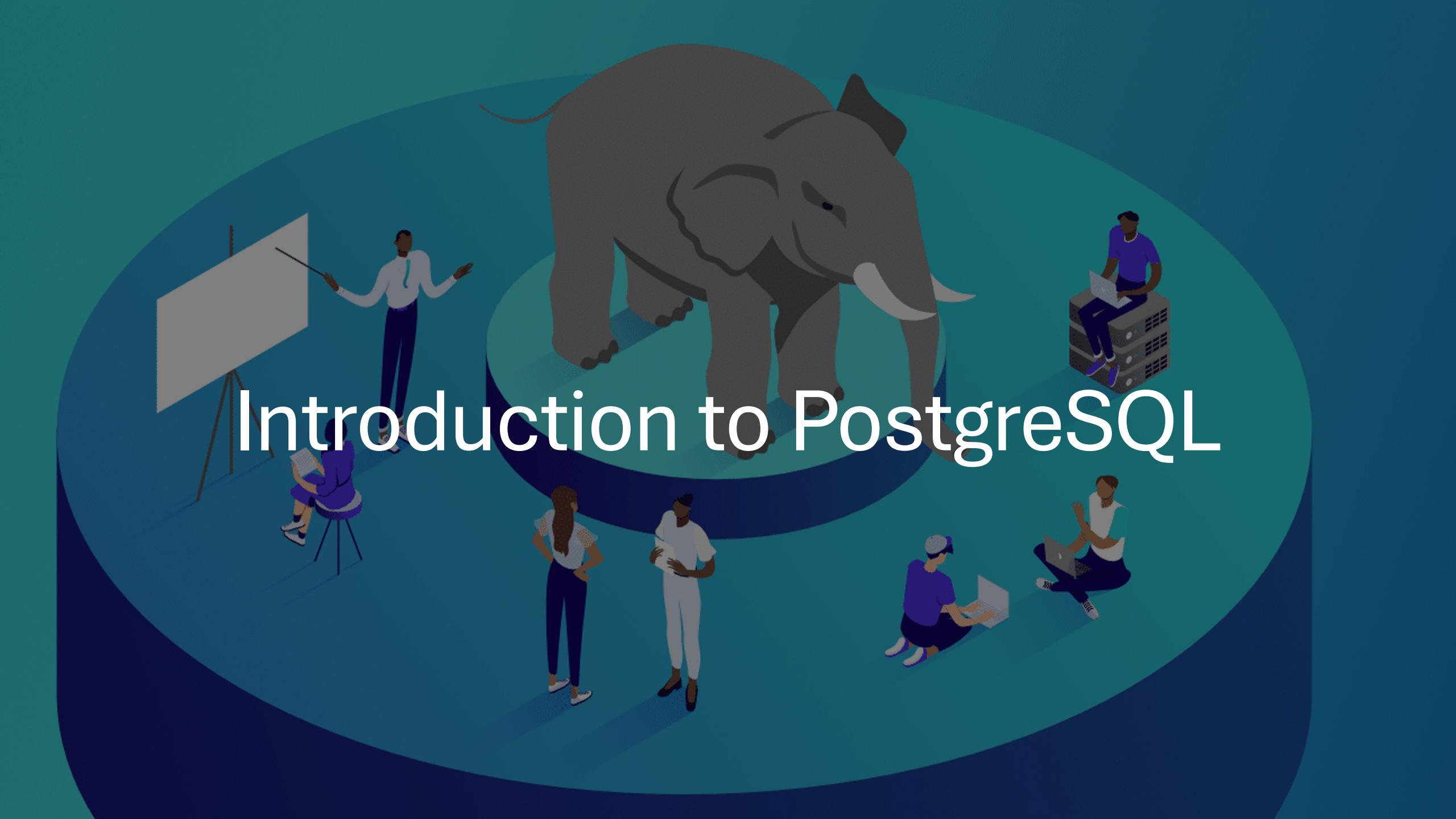
PostgreSQL vs Oracle: Key architectural differences



PostgreSQL installation & tools (pgAdmin, DBeaver)



Overview of pg_catalog, schemas, roles, and databases



Introduction to PostgreSQL

What is PostgreSQL?



PostgreSQL (Postgres)



An advanced open-source



Relational Database Management System (RDBMS).

What is PostgreSQL?

Known for

Robustness

Extensibility

Standards compliance

What is PostgreSQL?



Designed to
handle



Single-machine
applications



Large-scale data
warehousing



Web services

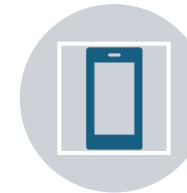
What is PostgreSQL?



Used for



Web



Mobile



Geospatial



Analytics
applications

What PostgreSQL Is (DBA View)

PostgreSQL is a

fully ACID-compliant,

MVCC-based,

enterprise-grade relational database

What PostgreSQL Is (DBA View)

Strong transactional integrity

High concurrency without read locks

Advanced indexing & extensibility

Native support for structured + semi-structured data

Proven stability in financial services



Key Contributors

- **Michael Stonebraker**
- The primary Architect
- Original Postgres project
- Key figure in database research

PostgreSQL Global Development Group (PGDG)



A group of
volunteers and
Companies



Oversee the
development



Maintenance of
PostgreSQL

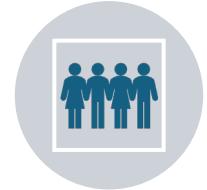
Community



Community-driven



Contributions from
developers
worldwide



Known for its
collaborative spirit



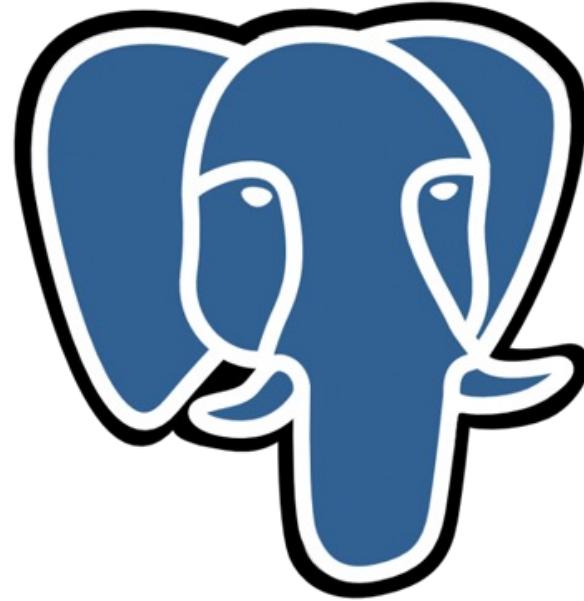
Extensive
documentation



Active mailing lists

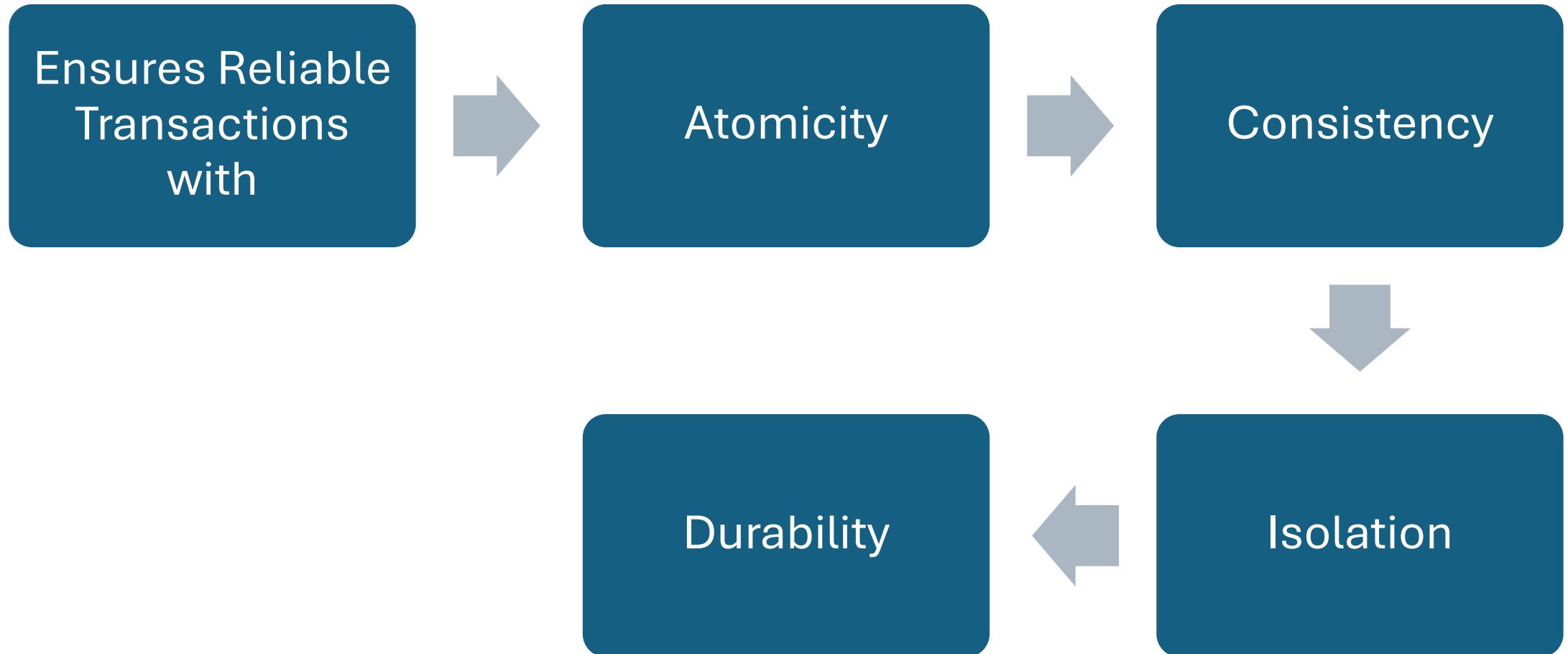


Key features and Benefits



Postgre^{SQL}

ACID Compliance



Atomicity

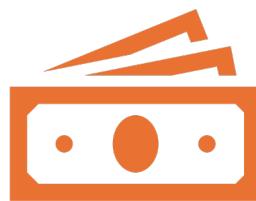
Each transaction is treated

Single "Atomic" Unit

Either completely succeeds or

Completely fails.

Atomicity



If any part of the transaction fails



Entire transaction is rolled back



Database remains unchanged.

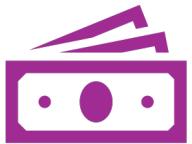
Example

If a
transaction
involves

transferring
money from

Account A to
Account B.

Example



Either both the
debit from



Account A and



The credit to
Account B



Happen or
neither happens.

Example

If the debit succeeds

but the credit fails,

the transaction is rolled back.

Account A's balance is restored

to its original state

Fidelity Use Case



Trade booking:



Insert trade record



Update account
balance



Update risk exposure

Fidelity Use Case

If any step fails
→

Entire
transaction is
rolled back

No “half-
booked” trades.

ACID Compliance

Provides robust support



For concurrent transactions



Without compromising data integrity

Consistency

Ensures that a transaction

From one valid state

To another valid state,

Maintain all predefined rules

Constraints, and triggers

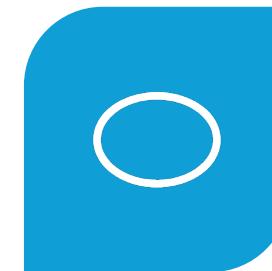
Consistency



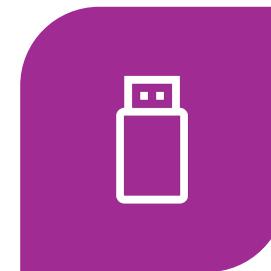
DATABASE
MUST



REMAIN
CONSISTENT

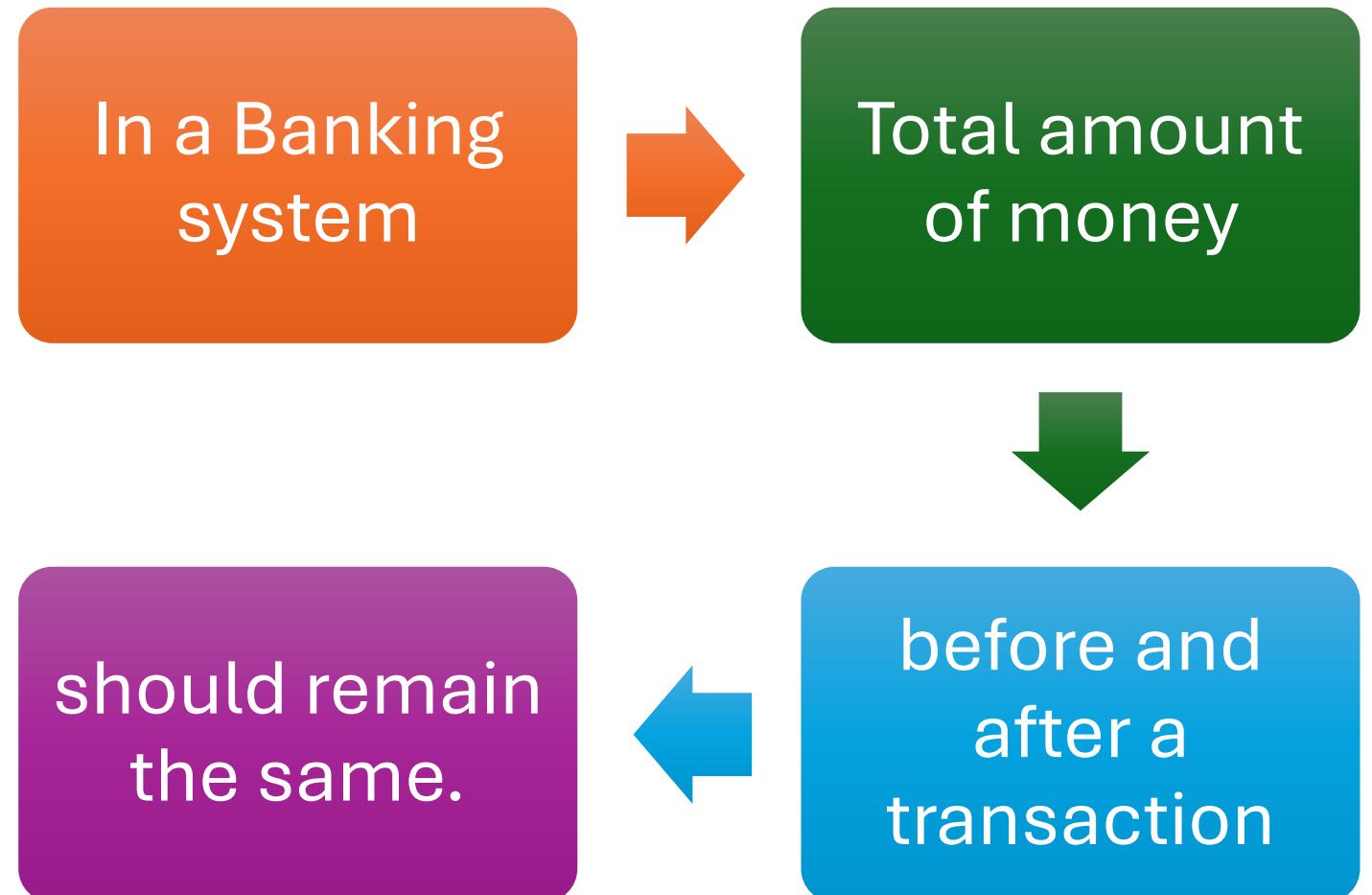


BEFORE AND
AFTER



TRANSACTION

Consistency



Fidelity Use Case

Retirement account:

Balance cannot go negative

Foreign key ensures customer exists

If violated →

Transaction fails immediately

Isolation

Transactions

Executed in

Isolation

From One another

Isolation

If two transactions

Running Concurrently

One transferring money from

Account A to Account B

Another from Account C to Account D

Isolation

Isolation ensures

Transactions

Do not see each other's

Intermediate states

Fidelity Use Case

Thousands of users viewing portfolios

Simultaneous trade updates

Readers are **not blocked** by writers

Durability

Once a transaction

Has been committed

Will remain

Even in the event of

a system failure

Durability



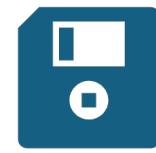
If a transaction
to update



A bank balance
is committed,



New balance is
guaranteed



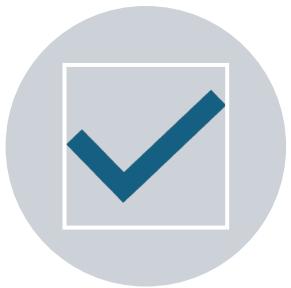
to be saved in
the database.

Fidelity Context

Power failure /
instance crash

Committed
transactions
are **never lost**

DBA Takeaway



PostgreSQL meets



Oracle and SQL Server



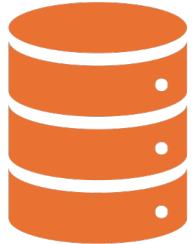
the same transactional
guarantees as



**no compromises for
finance.**

Advanced Data Types

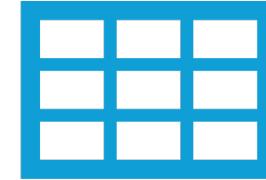
JSON/JSONB



Efficient storage



Querying of



JSON data.

Arrays



Support for



Multi-dimensional



Arrays

Hstore



Key-value pairs

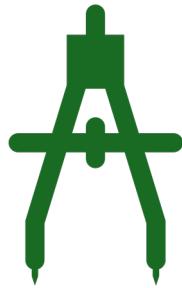


Storage

Geometric Types



Points,

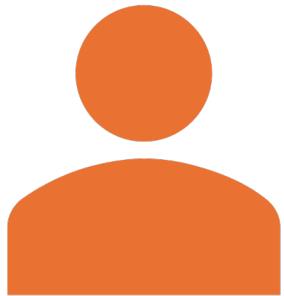


lines

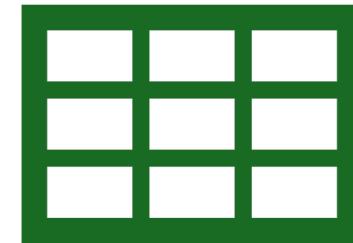


polygons

Custom Types



Users can define

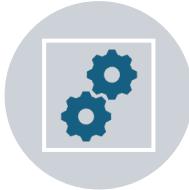


Own data types.

Extensibility



Users can
create



Custom
functions



Operators,

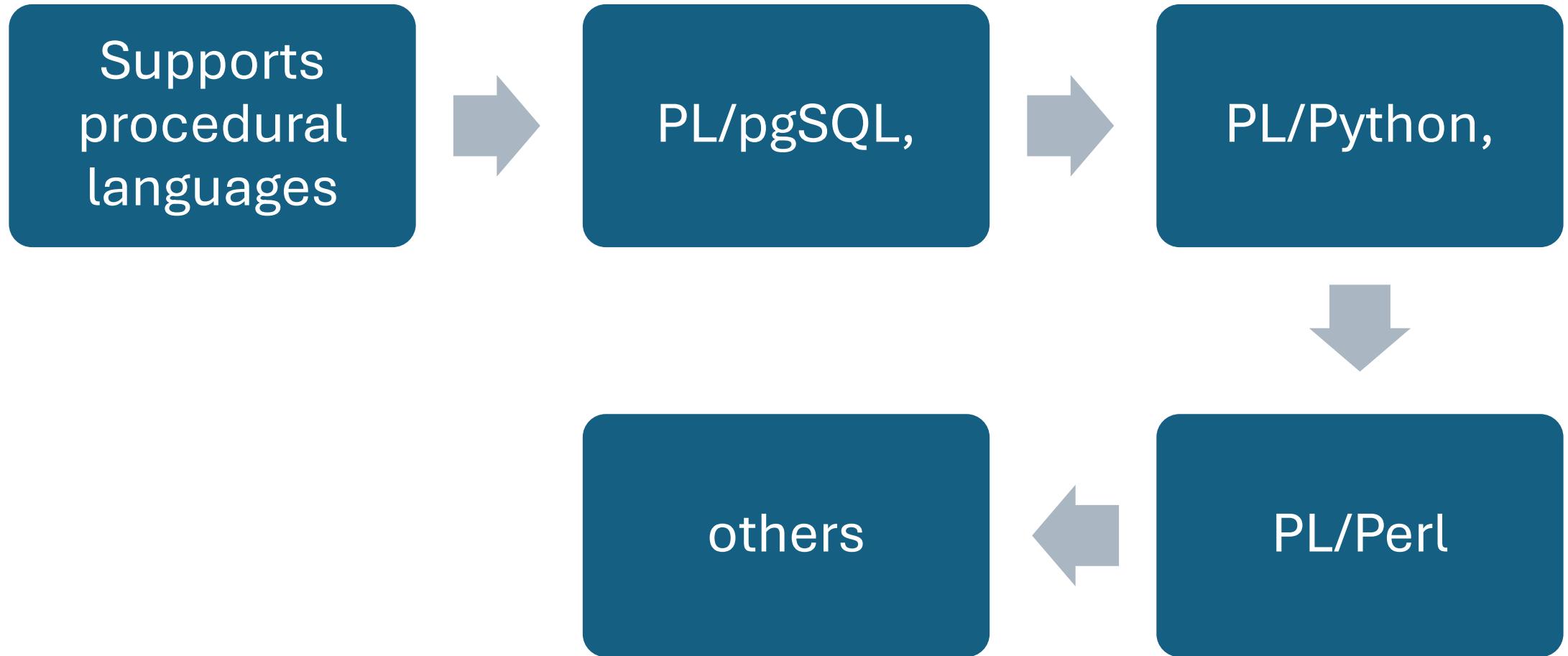


Data types



index types.

Extensibility



Extensibility



Extensions like



PostGIS (for
geospatial data)



Full-text search



Easily integrated

Multi-Version Concurrency Control (MVCC)



Allows multiple transactions



to occur simultaneously without locking.



Ensures data consistency



High performance

What MVCC Means?

PostgreSQL
keeps

**Multiple
versions of a
row**

To support
concurrency.

What MVCC Means?

Readers do not block writers

Writers do not block readers

Each transaction sees

a consistent snapshot

How PostgreSQL MVCC Works?

Each row (tuple) has:

xmin → Transaction ID that created it

xmax → Transaction ID that deleted/updated it

How PostgreSQL MVCC Works?

When a row is updated:

Old version remains

New version is created

Visibility depends on transaction snapshot

Comparison with Oracle & SQL Server

Database	MVCC Implementation
Oracle	Undo segments
SQL Server	Version store (TempDB)
PostgreSQL	Heap-based row versions

Indexing



Supports various
index types



B-tree,



Hash,



GiST,

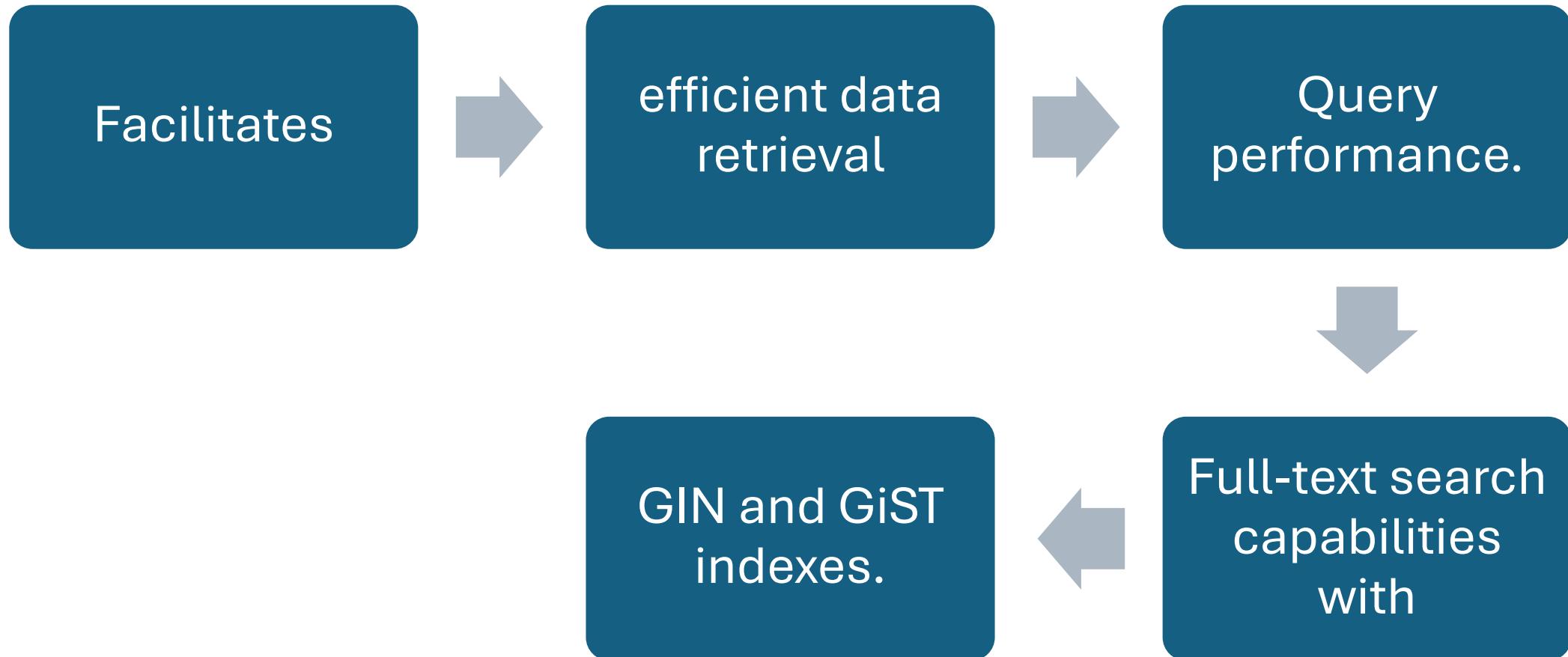


GIN



BRIN

Indexing



Foreign Data Wrappers (FDW)

Allows integration with

other databases and data sources.

Enables querying external data

as if it were a part of

the PostgreSQL database.

Full-Text Search



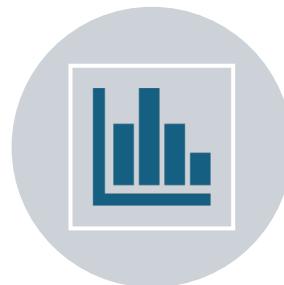
Built-in support for



full-text search
capabilities.



Indexing and querying
of



text data for fast search
results

Replication and High Availability

Supports both

Synchronous

Asynchronous

Replication

Replication and High Availability



STREAMING
REPLICATION



REAL-TIME DATA
REDUNDANCY



LOGICAL
REPLICATION



SELECTIVE DATA
SYNCHRONIZATION

Partitioning



Declarative
partitioning



for efficient
management



of large tables.

Partitioning

Supports

Range,

List,

Hash

composite partitioning methods.

Security



Robust access control
mechanisms



with roles and
permissions.



SSL support for

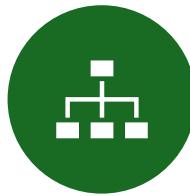


secure client-server
communication.

Security



Advanced
features like



row-level
security and



data
encryption.

Performance Optimization

Parallel Query
execution

for faster
processing

of large
datasets.

Performance Optimization

Query planner

Optimizer

for efficient

Query execution

Performance Optimization



CACHING MECHANISMS



TO IMPROVE
PERFORMANCE.

Backup and Recovery

Comprehensive backup and

restore options with

tools like pg_dump and

pg_basebackup.

Backup and Recovery



Point-in-time
recovery (PITR)



for restoring
databases



to a specific state.

Benefits of PostgreSQL

Open Source and Free

PostgreSQL is open source,
allowing for free usage,
modification, and distribution.
No licensing costs,
making it cost-effective
for organizations

Flexibility

Highly extensible and
adaptable to various use cases.
Suitable for a wide range of applications,
from small-scale to
large-scale enterprise systems.

Community and Support



Strong, active community



providing extensive documentation,



support, and regular updates.



Numerous third-party tools and



extensions available.

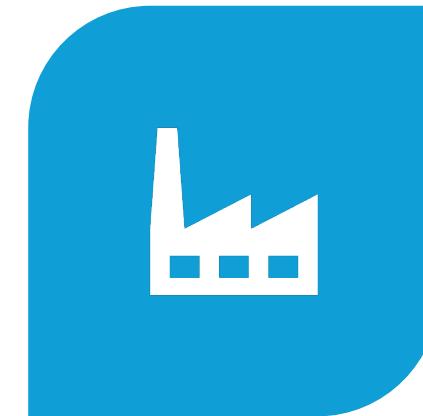
Reliability and Stability



PROVEN TRACK
RECORD OF



RELIABILITY AND
STABILITY IN



PRODUCTION
ENVIRONMENTS.

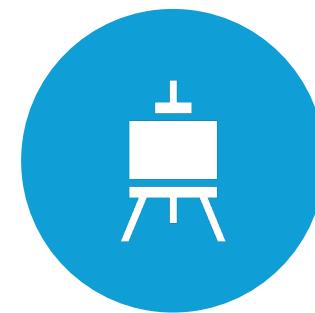
Standards Compliance



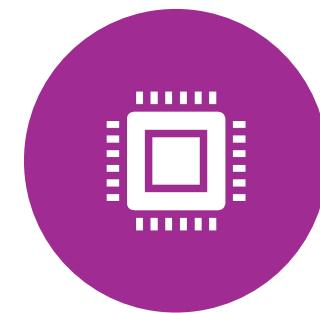
ADHERES TO SQL
STANDARDS,



ENSURING
COMPATIBILITY AND



EASE OF USE FOR
DEVELOPERS



FAMILIAR WITH
SQL.

Standards Compliance



REGULAR UPDATES



TO MAINTAIN
COMPLIANCE



WITH EVOLVING
STANDARDS.

Cross-Platform Compatibility



Runs on various operating systems



including Windows, macOS, and Linux.



Supports integration with



Various programming

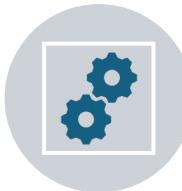


languages and frameworks.

Performance



Advanced indexing and



query optimization
techniques



ensure high
performance.



Scalability to
handle



large volumes of
data and



high transaction
loads.

Data Integrity

Strong support for data integrity

through constraints,

triggers, and foreign keys.

Ensures accurate and

consistent data storage and

retrieval.

Geospatial Capabilities

PostGIS extension

provides robust support

for geographic information systems (GIS).

Ideal for applications

requiring spatial data management.

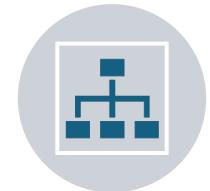
Enterprise Features



Comprehensive
feature set



that meets the
needs of



enterprise-level
applications.



Support for
complex queries,



transactions

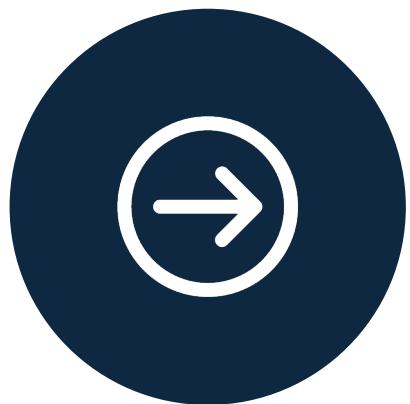


data analytics.

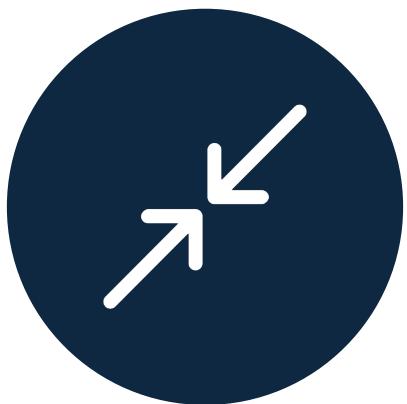
Core Capabilities (DBA-Relevant)

Capability	PostgreSQL Strength	Fidelity Use Case
ACID Transactions	Full durability & consistency	Trade processing, portfolio updates
MVCC	Readers never block writers	High concurrency dashboards
Advanced Indexing	B-tree, GIN, BRIN, Partial	Reporting + time-series data
JSONB	Binary JSON with indexing	Flexible investment attributes
Partitioning	Native range/list/hash	Historical trade data
Extensibility	Extensions, FDWs	Data federation & analytics
Open Source	No license lock-in	Cost optimization

Key DBA Takeaway



POSTGRESQL GIVES DBA
MORE RESPONSIBILITY,



NOT LESS — ESPECIALLY
AROUND



VACUUM, STATS, AND
PLANNER BEHAVIOR.

PostgreSQL vs Oracle vs SQL Server vs AWS RDS PostgreSQL

Area	PostgreSQL	Oracle	SQL Server	AWS RDS PostgreSQL
Licensing	Free	Very expensive	Expensive	Pay-as-you-use
MVCC	Heap-based	Undo-based	TempDB-based	Same as PostgreSQL
HA	Replication-based	RAC / DG	AlwaysOn	Managed Multi-AZ
OS Access	Full	Full	Full	✗ No
Vacuum / Cleanup	DBA-managed	Undo-managed	Auto	DBA-tuned
Cloud Fit	Excellent	Limited	Moderate	Excellent



**Thank you for
your support and
patience**

Surendra Panpaliya
Founder and CEO
GKTC Innovations
<https://www.gktcs.com>